Appendix A3

Biological Opinion

United States Department of the Interior
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119

In Reply Refer To
6-UT-04-F-008

Mr. Don Metzler, Moab Project Manager
U.S. Department of Energy
2597 B¾ Road
Grand Junction, Colorado 81503

Dear Mr. Metzler:

Subject: Biological Opinion on the Surface and Ground Water Remediation at the Moab, Utah. Uranium Mill Tailings Radiation Control Act (UMTRCA) Site

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the Fish and Wildlife Service's final biological opinion for impacts to federally listed endangered species for Department of Energy's (DOE) proposed action to remediate surface and ground water contamination at the Moab Site. Reference is made to your August 30, 2004, correspondence (received in our Utah Field office on August 31, 2004) which transmitted a biological assessment for our approval and requested initiation of formal consultation for the subject project. Our letter of September 20, 2004 approved the biological assessment as final and initiated formal consultation.

This biological opinion is based on information presented in the August 2004 biological assessment, the November 2004 Draft Environmental Impact Statement, the December 2003 Site Observational Work Plan, and other sources of information. I concur that aspects of the ground water remediation component of the proposed action may adversely affect the endangered Colorado pikeminnow *(Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and critical habitat.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat. Section 3(5)(A) of the Act defines critical habitat as: (i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features, (I) essential to the conservation of the species, and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. "Conservation" means the use of all

methods and procedures that are necessary to bring an endangered or a threatened species to the point at which listing under the Act is no longer necessary.

Based on the information provided in the biological assessment, I concur that the proposed action may affect but is not likely to adversely affect, the threatened bald eagle (*Haliaeetus leucocephalus*), the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), the threatened Mexican spotted owl (*Strix occidentalis lucida*), the endangered Black-footed ferret (*Mustela nigripes*), the candidate yellow-billed cuckoo (*Cocyzus americanus*), and the candidate Gunnison sage grouse (*Centrocercus minimus*). The bald eagle, southwestern willow flycatcher, and western yellow-billed cuckoo have been reported near the Moab Site, but their presence is seasonal and likely infrequent due to their migratory nature. Potential habitat exists for the Mexican spotted owl west of the site, although not close to the site. Therefore, potential effects on these species would be considered discountable. At the Crescent Junction disposal site location, the only species of concern are the bald eagle and black-footed ferret due to the possible occurrence of associated suitable habitat. Based on available information, it is unlikely that these species are present; therefore, potential adverse effects would be considered discountable.

In addition, I concur with the determination of no effect for the threatened Jones' cycladenia (*Cycladenia jonesii*), the threatened Navajo sedge (*Carex specuicola*), and the endangered clay phacelia (*Phacelia argillosa*) as these species are not known to occur in the project areas.

CONSULTATION HISTORY

The Atlas Moab Mill is located on the west bank of the Colorado River about 3.7 km (2.3 mi) northwest of Moab, Utah. The property and facilities were originally owned by the Uranium Reduction Company and regulated by the Atomic Energy Commission, precursor to the NRC. The mill and site were acquired by Atlas Corporation in 1962. Atlas activities at the Moab Mill site were covered by NRC Source Material License SUA-917, which was renewed in 1988. The mill ceased ore milling operations in 1984 and has been dismantled except for one building that DOE currently uses for maintenance and storage.

The USFWS=s Utah Field Office has been involved with the proposed reclamation of the Atlas mill tailings since 1979. At that time, the Department of Interior provided comments which were included in the Final Environmental Statement for the Atlas site. These comments included reference to the proposed critical habitat designation for two endangered fish, the humpback chub and Colorado pikeminnow.

In 1983, the USFWS identified in a letter to the Assistant Regional Director regarding a review of the Emergency and Remedial Response Information System Inventory, that the only site which may aversely affect threatened or endangered species was the Atlas Mineral Corporation mill tailings pile at Moab, Utah. The USFWS identified likely effects to Colorado pikeminnow and razorback sucker.

On August 28, 1992, the USFWS provided the Nuclear Regulatory Commission (NRC) with a letter identifying the presence of four endangered fishes in the Colorado River. This letter recommended that reclamation plans ensure that mill tailings material never enter the Colorado

River system, particularly over the long term when there may not be personnel or equipment to deal with problem situations. For example, in the middle 1980's the river level rose to the base of the tailings pile and equipment operators were barely able to keep the pile from sloughing into the river. At that time the USFWS advised the NRC that any depletion of water from the Colorado River system, including water used in dust suppression, is considered a Amay affect@ on the endangered Colorado River fish.

On May 13, 1994, the USFWS sent a letter to the Secretary, NRC, providing review and comment on the Notice of Intent to prepare an Environmental Impact Statement. In this letter, the USFWS identified and attached our August 1993 memoradum from our Regional Office in Denver that provided extensive comments on the Environmental Assessment. Issues included water depletion from the Colorado River; groundwater contamination; release of toxic elements; the lack of a discussion of laboratory practices for chemical analyses of toxic elements; selenium in surface water; radiological hazards to wildlife and Atake@ under the Migratory Bird Treaty Act; the lack of contaminant studies in fish, and whether the area would truly be a maintenance free closed system for 200--1,000+ years.

On November 2, 1994, the USFWS provided an updated list of species that may be affected by the reclamation of the Atlas mill tailings, this time to Oak Ridge National Laboratory, Tennessee. Oak Ridge was a consultant working for the NRC on preparation of the Environmental Impact Statement for the proposed action. In this letter the USFWS identified that, not only were four endangered Colorado River fishes (Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub) likely to occur in the vicinity of the proposed project site, but that the peregrine falcon (*Falco peregrinus*) and Jones cycladenia (*Cycladenia humilis* var. *jonesii*) also may be present. The USFWS reiterated that indirect effects could result from water depletions associated with the project. Water depletions, including water used for construction activities such as dust suppression, drilling, and mixing of concrete, from the upper Colorado River Basin is considered a jeopardy and an adverse modification of designated critical habitat for the endangered Colorado River fishes.

On January 11, 1995, the USFWS provided comments on the Preliminary Draft Environmental Impact Statement (PDEIS). In these comments the USFWS identified that it did not agree with the conclusions drawn in the PDEIS regarding tailings contamination of the Colorado River. The PDEIS concluded minimal impact on water quality and minimal toxicity effects to wildlife. The USFWS identified that some contaminants of concern can bioaccumulate to harmful levels in wildlife even when contaminant levels remain below water quality standards, and that sampling of aquatic biota is the best way to determine if contaminants are bioaccumulating in the food chain. Dilution by the Colorado River was not an effective means of mitigation for contaminants being carried into the river from the Atlas mill tailings pile. Selenium contamination was a concern and the literature indicated detrimental effects on fish and waterfowl from selenium levels of 1-3 Fg/L in water (Peterson and Nebeker 1992; Hamilton and Waddell 1994; Skorupa and Ohlendorf 1991). Furthermore, USFWS comments identified inadequate sediment and biota sampling in the river and in the Scott M. Matheson Wetlands Preserve across the river channel and recommended sampling benthic invertebrates, aquatic plants, and nonendangered fish. The PDEIS provided inadequate radiological hazard evaluation, and an inadequate examination of the environmental impacts of a tailings pile failure.

In April 1995, contaminants staff from the USFWS=s Utah Field Office participated in a 2-day meeting in Moab to determine necessary studies to characterize the tailings pile constituents and to determine what leachates, if any, were escaping from the pile into the Colorado River. At this meeting the Federal representatives developed a list of recommended objectives and protocols for the Atlas/NRC study of the Colorado River below the Atlas tailings pile. The USFWS expressed a need for additional data at the site in order to make informed decisions on environmental impacts. These recommendations were submitted to the NRC and their consultants. For a variety of reasons, most of the recommended data collections were not conducted.

On November 2, 1995, the USFWS received the biological assessment on the proposed reclamation of the Atlas mill tailings from the NRC with a request for formal consultation pursuant to the Endangered Species Act of 1973, as amended. Review of the biological assessment prompted the USFWS to request additional materials and analysis in a letter dated February 15, 1996. The limited data did not accurately assess potential impacts to the endangered fish species in the Colorado River, and required additional analyses.

On March 28, 1996, the USFWS forwarded comments on the Draft Environmental Impact Statement to the National Park Service. The National Park Service coordinated Department of the Interior comments on the Draft document. After having fully reviewed the Draft Environmental Impact Statement and the Biological Assessment and receiving the results of some additional analyses, the USFWS provided the NRC with a letter, on July 22, 1996, which related its ongoing concerns regarding the paucity of data on toxic elements released into the Colorado River system from the Atlas mill tailings pile, as well as the inconsistency in data results. Additionally, the USFWS recommended a meeting between the USFWS, the NRC, and Atlas Corporation to discuss additional data needs.

On August 15, 1996, the USFWS met with the NRC and Atlas Corporation to discuss data needs and USFWS comments on the Draft Environmental Impact Statement. The Atlas consultants, Harding-Lawson Associates, presented some additional data concerning the hydrology of the region and the studies that had been conducted to date.

On October 21, 1996, USFWS staff again met with Atlas Corporation and the NRC to discuss regional hydrogeology, surface water quality issues, the potential effects of the tailings pile on the Colorado River and NRC requirements for the Ground Water Corrective Action Plan.

One additional meeting was held with USFWS staff, Atlas Corporation, NRC, and Department of Interior personnel to discuss the Departments= comments on the Draft Environmental Impact Statement and Atlas=s response to these comments. This meeting was held on December 17 and 18, 1996.

On January 14, 1997, the USFWS provided the NRC with a letter which detailed ongoing issues relating to the section 7 consultation and the National Environmental Policy Act process including: completion of the National Environmental Policy Act process prior to completion of the section 7 consultation; the possible impacts to endangered species from the contaminated groundwater underneath the tailings pile; impacts to listed species from the relocation of Moab Wash; evaluation of the analytical methods used to characterize the leachate from the pile; the

lack of data characterizing the tailings pile itself; high concentrations of ammonia at and below the Atlas site, and the presence of southwestern willow flycatcher habitat at the site. The southwestern willow flycatcher had not been included in earlier species lists provided by the USFWS because the species was not listed as endangered until February 27, 1995.

On January 30, 1997, the USFWS received the supplemental biological assessment on the proposed reclamation of the Atlas mill tailings, with a cover letter requesting formal section 7 consultation pursuant to the Act.

On February 3, 1997, the USFWS received a letter from Atlas Corporation transmitting Atlas=s perspective on several of the procedural or process and technical issues identified in the USFWS=s January 14, 1997, letter to the NRC.

On February 6, 1997, the USFWS received a revised letter from Atlas Corporation requesting that the USFWS replace the February 3, 1997, letter with this new letter. There were no substantive changes or alterations.

On February 18, 1997, the USFWS sent a letter to the NRC acknowledging receipt of the supplemental biological assessment and request for formal consultation. In that letter the USFWS identified that it would provide the NRC with a biological opinion by June 15, 1997.

On March 27, 1997, the USFWS received a letter from Atlas Corporation providing Colorado River water depletions information and proposed actions for the Ground Water Corrective Action Plan.

On June 26, 1997, the USFWS released its Draft Jeopardy Biological Opinion for the proposed reclamation of the Atlas mill tailings site in Moab, Utah. Comments on the Draft Biological Opinion were received from the NRC, dated August 12, 1997, and Atlas Corporation and their consultants, dated August 6, 1997.

On September 9, 1997, USFWS staff participated in a meeting arranged by the Grand Canyon Trust, with staff from Oak Ridge National Laboratory/Grand Junction, the National Park Service, USFWS, the State of Utah (by phone), and Grand Canyon Trust, to discuss the potential effects of contaminated groundwater discharge to the Colorado River from the Atlas pile. The Oak Ridge National Laboratory/Grand Junction was assigned the task of developing a sampling scheme to more accurately delineate the content and width of the contaminant plume. A proposal was distributed September 19, 1997.

Given the differing opinions concerning the USFWS=s Draft Jeopardy Biological Opinion, the entire matter was elevated to the Council of Environmental Quality and the Office of the Secretary of Interior. The Council of Environmental Quality approved the Oak Ridge National Laboratory/Grand Junction study proposal.

On October 23, 1997, a meeting was held in the USFWS=s Denver office to address the status of the Oak Ridge National Laboratory/Grand Junction study proposal and refine the work plan. Participants included the USFWS, Oak Ridge National Laboratory/Grand Junction, NRC, Atlas Corporation, and Atlas=s consultants, Harding-Lawson Associates. At the meeting Oak Ridge

National Laboratory/Grand Junction agreed to perform the work and provide a report 60 days following the awarding of funds. Subsequently, Atlas Corporation, the NRC, and the USFWS agreed that following receipt of the Oak Ridge National Laboratory/Grand Junction report, the USFWS would issue a revised draft biological opinion within 30 days. The NRC and Atlas Corporation would have 10 days to review the revised draft biological opinion and provide comments to the USFWS. The USFWS would then have an additional 30 days to finalize the biological opinion. On November 10, 1997, Oak Ridge National Laboratory/Grand Junction began work on the approved study and on January 9, 1998, submitted the final report to the USFWS (received on January 12, 1998) and the NRC.

Upon receipt and review of the January 9, 1998, Oak Ridge National Laboratory/Grand Junction (1998a, 1998b) studies, the USFWS determined that additional modeling would be necessary to determine the long term impacts of leaving the tailings pile in place as opposed to moving it. An additional study that supplemented the earlier modeling effort was agreed to by the NRC and Atlas Corporation and conducted by Oak Ridge National Laboratory/Grand Junction (1998c). Shortly into this modeling effort, the NRC decided that a further modeling effort, one which modeled the long term contaminant levels in the Colorado River, was necessary. On February 5, 1998, USFWS staff met with the NRC, Atlas Corporation, Harding-Lawson Associates, and Oak Ridge National Laboratory/Grand Junction to discuss future modeling needs. At this meeting Oak Ridge National Laboratory/Grand Junction presented the completed supplemental modeling requested by the USFWS. After hearing the presentation, the NRC determined that additional future modeling was not necessary. All parties agreed to proceed with a revised draft biological opinion, to be delivered to the NRC by March 2, 1998.

In a letters to NRC dated March 2, 1998 and March 11, 1998, Atlas Corporation granted a 30-day extension for issuance of the USFWS=s revised draft biological opinion. The letter from Atlas Corporation stated that the length of this extension would be determined pursuant to discussions to be immediately undertaken among Atlas, the NRC, and the USFWS. This consultation timeline was in part dependent on a response from the USFWS whether the NRC could require Atlas Corporation to move the tailings pile out of the Colorado River floodplain. The USFWS provided said response in a letter dated March 11, 1998, which stated that the NRC did not have the authority to make Atlas Corporation move the pile.

On April 14, 1998, the USFWS issued a Revised Draft Biological Opinion. Numerous comments were received on the Revised Draft Biological Opinion from the NRC and Atlas Corporation. These comments facilitated a meeting that was held between the NRC, the USFWS, and Atlas Corporation on May 21 and 22, 1998 followed by subsequent conference calls. All parties agreed that upon receipt of a letter from Atlas Corporation identifying several specific time frames for completion of proposed actions, the USFWS would issue a final biological opinion within 30 days. The USFWS received said letter on May 29, 1998.

In a letter dated June 30, 1998, the parties agreed to an additional extension. The USFWS agreed to complete and transmit a draft final biological opinion to the NRC and Atlas Corporation by July 10, 1998, and the final biological opinion by July 20, 1998. On July 9, 1998, the USFWS completed and transmitted the draft final biological opinion.

In a conference call on July 16, 1998, the parties agreed to extend the date of issuance of the final biological opinion to July 24, 1998. Letters from Atlas and the NRC agreeing to the extension were received by the USFWS on July 20, 1998.

The USFWS issued its Final Biological Opinion on July 29, 1998. At that time, it was the USFWS's opinion that capping the pile in place would jeopardize the continued existence of the razorback sucker and Colorado pikeminnow due to continued leaching of contaminants (primarily ammonia) into the Colorado River, water depletion in the river, and adverse modification of designated critical habitat. This opinion was based primarily on the lack of a ground water corrective action plan; a reasonable and prudent alternative is summarized below:

1. Develop a revised groundwater corrective action plan necessary to reduce leaching from the pile and other sources such that the fish are no longer jeopardized and the habitat is no longer adversely modified.
2. Assure that ammonia levels will be reduced to levels avoiding future jeopardy to the endangered fish. The NRC shall incorporate, whether by order or through the request of Atlas Corporation, ammonia as a new constituent in the license held by Atlas Corporation.
3. In order to more effectively determine cleanup levels required to remove jeopardy to listed species, the Service initiated previously planned bioassay studies. These bioassay studies will be conducted by the Columbia Laboratory of the Biological Resources Division, U.S. Geological Survey and shall be initiated in July 1998. In order to effectively conduct these studies the Service, and other personnel participating in the study, will require access to the Atlas property to carry out the study. The NRC shall ensure that access is permitted to the site for purposes of conducting the study.
4. The NRC shall consult with the Service, pursuant to section 7, before establishing alternate concentration limits, and exceptions thereto, at the site.
5. Depletion impacts for 154.3 ac-ft (ac-ft) of Colorado River water were addressed through the Recovery Program.

The Final Biological Opinion provided a set of reasonable and prudent measures that would help to minimize take. The USFWS also concluded that the proposed action would not jeopardize the southwestern willow flycatcher and provided reasonable and prudent measures and terms and conditions to minimize take of that species. The peregrine falcon was not addressed in the Biological Opinion.

NRC published its final EIS in 1999. In March 1999, a trust was created to fund future reclamation and site closure. Atlas was released from all future liability with respect to the uranium mill facilities and tailings impoundment at the Moab Site. The bankruptcy court appointed NRC and the Utah Department of Environmental Quality (UDEQ) beneficiaries of the Atlas bankruptcy trust. Later, the beneficiaries selected PricewaterhouseCoopers to serve as trustee. In October 2000, the Floyd D. Spence National Defense Authorization Act (Floyd D. Spence Act) for fiscal year (FY) 2001 (Public Law 106-398) amended UMTRCA Title I (which expired in 1998 for all other sites except for ground water remediation and long-term radon management), giving DOE responsibility for remediation of the Moab Site. That act also mandates that the Moab Site be remediated in accordance with UMTRCA Title I "subject to the

availability of appropriations for this purpose" and requires that DOE prepare a remediation plan to evaluate the costs, benefits, and risks associated with various remediation alternatives. The act further stipulates that the draft plan be presented to the National Academy of Sciences (NAS) for review. NAS is directed to provide "technical advice, assistance, and recommendations" for remediation of the Moab Site.

Under the act, the Secretary of Energy is required to consider NAS comments before making a final recommendation on the selected remedy. If the Secretary prepares a remediation plan that is not consistent with NAS recommendations, the Secretary must submit a report to Congress explaining the reasons for deviating from those recommendations. DOE's *Preliminary Plan for Remediation* (DOE 2001) for the Moab Site was completed in October 2001 and forwarded to NAS. After reviewing the draft plan, NAS provided a list of recommendations on June 11, 2002, for DOE to consider during its assessment of remediation alternatives for the Moab Site. DOE addressed the NAS recommendations in their internal scoping for the project EIS and in their draft EIS which was made available for public comment on November 5, 2004. Ultimately, DOE will need to finalize their RAP, which will need to be approved by the NRC. The RAP would provide the detailed engineering reclamation design and incorporate a ground water compliance strategy and corrective actions. DOE indicates that the RAP would likely follow issuance of a NEPA Record of Decision.

In letters dated, April 25, 2000 and June 28, 2000, the USFWS requested the NRC to reinitiate Endangered Species Act Section 7 consultation based on new information relating to higher than anticipated fish mortality from contaminated ground water entering the Colorado River and delays in submitting a ground water corrective action and dewatering plans. NRC responded on May 25, 2000 and September 22, 2000, with a request that the USFWS answer questions and issues raised by counsel for the trustee including the necessity and appropriateness for the reinitiation. On December 7, 2000 the USFWS again requested the NRC to reinitiate consultation due to the profound and fundamental changes in the proposed remediation plan resulting from passage of the Floyd D. Spence Act, which required that the site be turned over to the DOE and authorized the trustee to undertake ground water remediation at the Atlas site in the interim. In their final response dated December 20, 2000, NRC declined to reinitiate consultation with USFWS and instead requested informal Section 7 consultation.

In a letter dated February 8, 2001, the USFWS indicated that they could not engage in informal consultation once formal consultation has been completed and withdrew the Final Biological Opinion. In that same letter the USFWS informally consulted on actions the NRC and the DOE had agreed needed to be accomplished prior to official transfer of the site. Responsibility for the mill site was officially transferred to DOE prior to October 30, 2001.

Since DOE acquired responsibility for the Moab Site, many activities, including characterization, maintenance and operational activities, and interim actions, have taken place. Before implementing these actions, DOE consulted regularly with USFWS concerning threatened and endangered species that may be affected by these activities. These consultations, and DOE determinations, resulted in concurrences by USFWS dated March 23, 2001, September 12, 2001, January 22, 2002, and April 5, 2004. In all cases, it was determined that these actions would not adversely affect the continued existence of any aquatic or terrestrial threatened or endangered species.

In support of the preparation of the draft EIS for remediation of the Moab Site, DOE sent a request for information to USFWS in March 2003. USFWS responded in April 2003 with an updated list of threatened, endangered, proposed, and candidate species that may occur in the potentially affected areas under the various alternatives.

On April 24, 2003, DOE and USFWS met in Salt Lake City to discuss the BA approach and scope. This meeting also included discussions regarding options for preparing a biological opinion prior to identifying a preferred alternative.

A teleconference with USFWS, DOE, the U.S. Environmental Protection Agency (EPA), and the Utah Department of Environmental Quality took place on July 9, 2003, to discuss the applicable numeric ammonia criteria.

On August 25, 2003, USFWS and DOE met in Salt Lake City to further discuss applicable risk-based criteria and standards to ensure the protection of endangered fish. On November 3, 2003, the draft BA was forwarded to USFWS for comment. DOE received initial comments on the BA in early December 2003. Following receipt of the comments, a meeting occurred on December 15, 2003. Additional comments were transmitted by USWFS in early January 2004, followed by telephone conferences to clarify issues and concerns.

On April 14, 2004, DOE submitted the final draft BA to USFWS. In June through August 2004, DOE and USFWS consulted extensively to resolve final comments on this document.

On August 10, 2004, USFWS provided formal comments to DOE on the final draft BA. DOE incorporated those comments and on August 30, 2004, sent a BA and a cover letter requesting our approval of that version as final. USFWS responded with a letter on September 20, 2004 accepting the latest version of the BA as final and committed to having a draft BO to DOE by January 31, 2005.

On January 31, 2005 the USFWS sent a letter requesting an extension on the draft BO due date until March 17, 2005. DOE agreed to that extension, via email on February 14, 2005.

On April 6, 2005, DOE announced their preferred alternatives for tailings disposition and ground water remediation. Off-site disposal at the Crescent Junction site was selected as the preferred disposal location for the tailings, and transportation by rail was the preferred transportation mode. DOE also selected active ground water remediation at the Moab site as its preferred ground water compliance strategy.

BACKGROUND

The Atlas tailings pile is about 0.8 km (0.5 mile) in diameter and 28.65 m (94 feet) high. It rises to an elevation of 1237 m (4058 ft) above mean sea level. The pile is located 3.7 km (2.3 mi) northwest of Moab, Utah and occupies about 53 ha (130 acres) of land about 230 m (750 ft) from the Colorado River. It consists of an outer compact embankment of coarse tailings and an inner impoundment of both coarse and fine tailings. An interim cover of uncontaminated earth covers the tailings. The amount of tailings is estimated to total 9.5 million metric tons (10.5 million tons).

Initial tailings pond construction was completed in 1956, and with the exception of brief periods, tailings were disposed in the pond continuously from initial startup in October 1956 until the mill ceased operations and was placed on standby status in 1984. The pile has five embankments that were raised to their present elevation of 1,237 m (4,058 feet) above mean sea level after Atlas's 1979 license renewal. A 5.5 m (18 foot) raise in embankment elevation to a projected final elevation of 1,242 m (4,076 feet) was reviewed and approved under License Amendment No. 7 dated June 30, 1982. However, the embankment raise was never initiated because the added capacity was not needed when the mill subsequently entered a long-term shutdown status.

During early operations Atlas utilized an acid leach process for uranium milling. During this period, lime was added to the mill tailings to help neutralize the tailings. In 1961 an alkaline leach process was initiated. In 1967 a new acid leach circuit was installed and, for a period of time, both the acid circuit and an alkaline circuit were operated. From 1982 through 1984, only an acid leach process was used with no neutralization of process water because a recycle process was in use.

To collect water draining from the tailings pile embankments, two sump pits were excavated in the 1980's, one on the northeast side of the pile and the other on the south end of the pile. Pumps were installed to collect the seepage water and pump it to an evaporation pond on top of the tailings pile. Water did not collect in the pits for several years, and the pumps were subsequently removed. The NRC amended Atlas=s license to allow disposal of radioactive contaminated solid waste in the south sump pit.

The 1982-1984 phase of operations appears to have resulted in increased metals mobilization as a result of the lower pH of the water and tailings associated with the acid leach circuit. After the NRC conformed its groundwater regulations to the Environmental Protection Agency=s, they required Atlas to initiate a compliance monitoring and corrective action program by July 1990. A revised program was prepared by Atlas and found acceptable with modification. The program included the establishment of groundwater quality standards, point-of-compliance wells, a background well, sampling frequency, groundwater sampling points, selected constituents for which the groundwater was to be analyzed, and enhanced drying of the tails. Wells were drilled into the tailings to pump water to an evaporative pond on the top of the tailings pile.

Atlas conducted cleanup of windblown tailings and other contaminated soils in several areas on the site. These areas were along the west side of State Route (S.R.) 279, between the tailings pile

and the highway, an area northwest of the tailings pile, and an area of about 3 ha (7 acres) southeast of the tailings pile. Cleanup involved excavating the windblown tailings and contaminated soil and placing them on the tailings pile.

Since DOE took over responsibility for the site in 2001, they have instituted environmental controls and interim actions to minimize potential adverse effects to human health and the environment in the short term. Controls have included storm water management, dust suppression, pile dewatering activities, and placement of an interim cover on the tailings to prevent movement of contaminated and windblown materials from the pile. Interim actions have included restricting site access, monitoring ground water and surface water, and managing and disposing of legacy chemicals. A pilot-scale ground water extraction system was implemented in summer 2003, which has intercepted a portion of the ground water contaminants discharging into the Colorado River. Contaminated ground water is pumped to the top of the pile for evaporation.

DESCRIPTION OF THE PROPOSED ACTION

DOE is proposing to remediate contaminated soils and materials and contaminated ground water at the Moab Site. In addition, DOE has determined properties in the vicinity of the Moab Site (vicinity properties) may contain contamination and require remediation. These properties include portions of the state highway and railroad rights-of-way, BLM property, and Arches National Park. Surface contamination at the Moab Site and vicinity properties would be consolidated at the Moab Site prior to transportation by railroad to a disposal site near Crescent Junction, Utah. The ground water remediation goal is to reduce concentrations of five contaminants reaching the Colorado River to acceptable risk levels within 10 years of the ROD. Ground water remediation, as proposed, seeks to reduce concentrations of ammonia reaching the Colorado River surface waters to protective levels. DOE presumes that by reducing ammonia concentrations the other contaminants will be reduced to protective levels as well. Following informal consultation with the Utah Field Office in 2003 and 2004 DOE implemented initial and interim actions to begin reducing ammonia concentrations prior to full implementation of proposed ground water remediation.

The following description of the proposed action is based on information provided in the biological assessment, the DEIS and the SOWP (DOE 2003a) and technical appendices to those documents.

Disposal Cell Recountouring, Stabilization, and Capping – Figure 1 provides a conceptual cross-section of the final condition of the disposal cell. The figure also illustrates the types and approximate dimensions of the materials that would be placed on the sides and top of the pile to contain radon emissions and stabilize the cell. This is a conceptual design and diagram only. The conceptual design is strictly intended to establish a reasonable basis for evaluating environmental impacts between the alternatives associated with this component of site remediation and reclamation. This assumed design is not intended to commit DOE to any specific cover design. A detailed design would be developed in DOE's Remedial Action Plan (RAP) following the ROD.

Should the final design differ substantially from the design considered here, DOE would assess the significance of these changes as they relate to the decision-making process and the requirements of NEPA and ESA.

Remediation of Surface Contamination: Disposal at the Crescent Junction Site

The tailings pile, contaminated on-site soils and materials not yet in the existing pile, and contaminated materials from the vicinity properties would be transported to the Crescent Junction Site. Contaminated materials would be transported by rail. Activities under the proposed action will therefore occur at the Moab Site as well as at the off-site disposal site: Crescent Junction.

Activities at the Moab Site would include grading and removing vegetation over almost the entire 439-acre site, both to prepare the site for subsequent activities and to remove surface contamination. These activities would remove remaining wildlife habitat (approximately 50 acres, primarily tamarisk) from the Moab Site. Other site activities would include removing any existing structures and creating temporary construction support facilities (such as laydown yards, material stockpiles, vehicle maintenance and refueling areas, and vehicle decontamination facilities).

In the past, tailings material was removed from the Moab Site and taken to off-site locations for a variety of purposes, such as backfill. In many cases, ore was stockpiled at various locations in the Moab area. For the purposes of analysis in the EIS, and based on available information and past experience, DOE has estimated that about 98 vicinity properties, may require remediation. All are relatively small (about 2,500 square feet [ft^2] and 300 cubic yards [yd^3]of material per site). These sites would be excavated and the materials transported by truck to the Moab Site, where they would be stockpiled for eventual disposal at the Crescent Junction Site.

In addition to the surface disturbance at the Moab Site, an additional 1200 acres would be subject to disturbance at the Crescent Junction site, borrow areas and for transportation. Additional activities at the disposal site would include preparing the disposal cell and constructing similar support facilities as at the Moab Site.

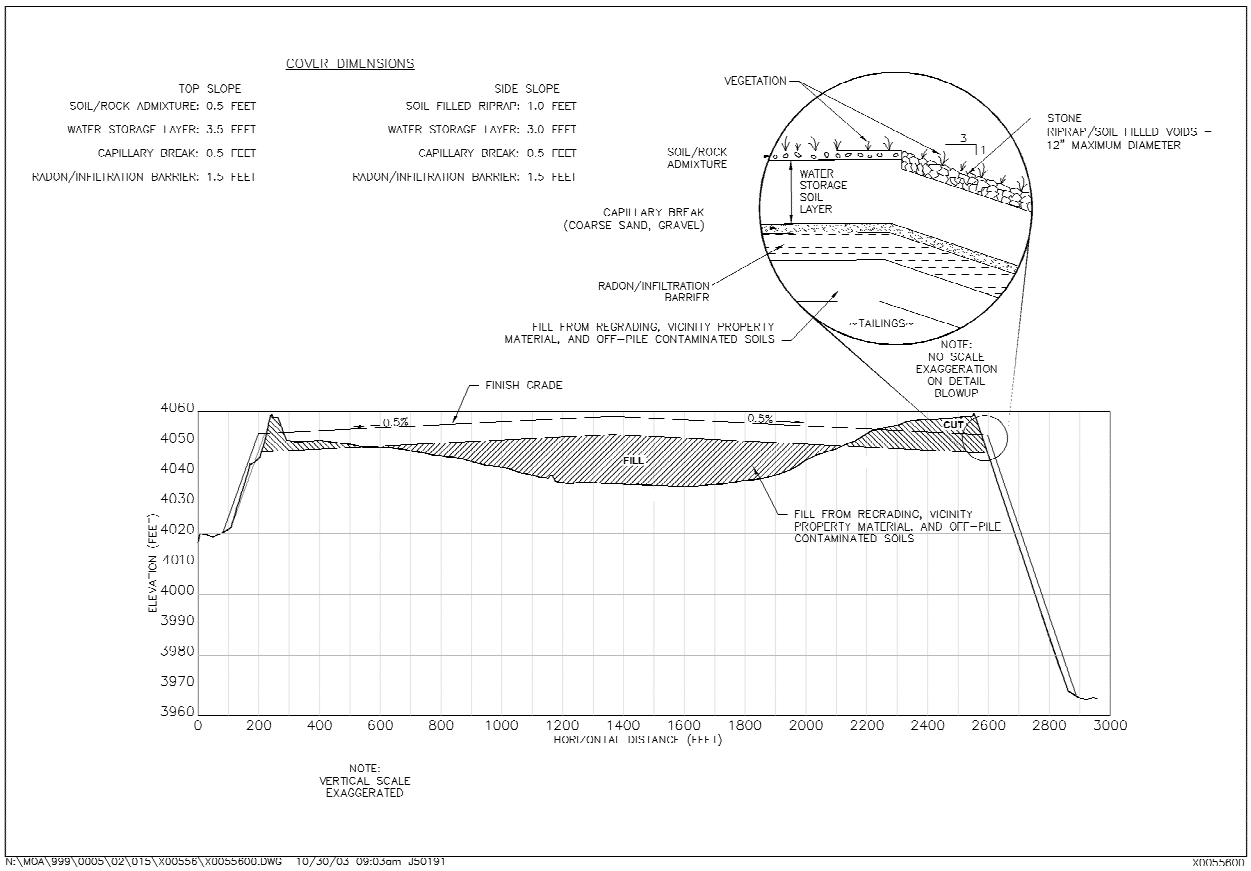

Figure 1. Cross Section of Disposal Cell designed for the Moab Site. Presented here as a conceptual design for the Crescent Junction Site. (reproduced from DEIS)

Table 1 shows areas of disturbance at borrow areas. The degree of disturbance would depend upon the borrow areas actually used and would be included in the RAP.

Rail transport would require construction of a loading facility at the Moab Site and some additional track and unloading facilities at the Crescent Junctin site.

Information provided in DOE's DEIS offers a more detailed description of activities associated with surface remediation: construction and operation at the Moab Site, characterization and remediation of vicinity properties, construction and operation at the borrow areas, preparation of contaminated materials for transport, final site reclamation and water depletions. These project details were reproduced from the DEIS.

Construction and Operations at the Moab Site -

Contaminated materials from vicinity properties would be transported to the Moab Site, stockpiled on site and prepared for transportation to an off-site disposal site. DOE projects surface remediation activities at the Moab Site would be complete in the year 2012 provided construction begins as proposed in 2007.

Preparation of contaminated materials for transport off-site - Before it could be transported by rail, the material in the tailings pile would have to be excavated and dried to a specified moisture content by drying in a process bed and mixing with drier material. To accomplish this, approximately 32 acres at the northwest and east base of the pile and an additional 14 acres around the top perimeter of the pile would be used as drying or processing areas. These areas would be accessed by temporary haul roads. There would be approximately seven separate 6- to 7-acre process beds in the areas. DOE has previous experience successfully moving wet tailings, including saturated slimes, at other UMTRCA sites such as at the Riverton (Wyoming), Rifle (Colorado), Monument Valley (Arizona), and Grand Junction (Colorado) sites.

Once the process beds and haul roads were constructed, pile excavation would begin. An excavating machine located on the perimeter of the pile would excavate from the center of the pile outward. The excavating machine would drag slimes from the center and pull them over and into the perimeter sands, providing some mixing during the excavation. The coarser tailings sands at the outer perimeter of the pile would be excavated and moved to the process beds using scrapers. This method would allow a progressive top-down excavation sequence that would maintain the stability of the perimeter tailings dike surrounding slimes and also allow continuous use of the perimeter area material for processing. As saturated slimes were excavated from the center of the pile, the material would be loaded onto trucks and taken to the process beds for mixing and drying. A tractor would turn and dry the graded material until it reaches a consistent moisture content suitable for truck or rail transport. Assuming dry tailings were available for mixing with wet tailings, the mixing and drying process for a load of excavated material would take approximately 3 days; if dry tailings were not available for mixing, the material would be processed for 7 days prior to shipment. The approximate maximum daily volume of material that could be placed for processing would be 15,500 yd^3 in each process bed of approximately 6 to 7 acres. Should tailings drying take additional time, slightly greater areas for drying would be necessary to allow sufficient inventory of tailings to be dried and transported according to the planned schedule. Once the material was sufficiently dry, it would transported by a conveyor system and loaded onto waiting gondola cars.

After excavation of the pile reached the assumed original grade, it would continue until the cleanup criterion had been met. On the basis of limited existing data, DOE estimates that subpile excavation to a depth of 2 ft would be required.

Final Site Reclamation - Release of portions of the site for future uses would depend on the success of site remediation. DOE's ultimate goal would be to remediate to unrestricted surface use standards. However, DOE would defer its decisions on the release and future use of the Moab Site pending an evaluation of the success of surface and ground water remediation. Some fencing would be required at least for the 75 years during which ground water remediation would be ongoing. Before backfill and site reclamation and following the removal of the temporary infrastructure, structures, and controls, DOE's contractor would verify that radium-226 concentrations in soil within the Moab Site boundary did not exceed EPA standards in 40 CFR 192. The entire site would then be graded and re-contoured. The water storage ponds would be backfilled to original grades prior to reclamation. Approximately 425,000 yd^3 of fine grained silty- to sandy-loam reclamation soil excavated from the selected borrow area (e.g. Floy Wash) borrow area would be imported as backfill for the Moab Site. Soils would be prepared for

planting by scarifying with a disk harrow. Moisture conditioning would be performed and the area seeded with native or adapted plant species.

Moab Wash would be reconstructed in its general present alignment. After removal of the tailings impoundment and contaminated soils, site topography and future land use are uncertain. Thus, to minimize costs and achieve fluvial stability, the channel would be re-established in its current location. Additional meanders may be added to increase travel distance of the water and reduce slope to mitigate future erosion caused by higher water flow velocity. The channel would be lined with riprap and designed to carry the estimated runoff volume for a 200-year flood. Larger flows would be allowed to flood into channel overbank areas.

DOE estimates that all 8,867,400 yd^3 of source materials (uranium mill tailings, pile surcharge, subpile soils, off-pile contaminated soils, and vicinity property materials) weighing approximately 12,000,000 tons would need to be hauled off site. Estimates of the time to transport contaminant offsite range from: 3.3. years if four round trips are completed per day to 1.6 years if 8 round trips are completed daily. DOE provides preliminary details addressing the wide ranging considerations of infrastructure needed at the Moab Site, at the Crescent Junction Site and points between in their DEIS.

Water Depletions - DOE estimates that on average of 130 - 235 ac-ft would be depleted annually for approximately 5 years to implement the preferred alternatives and transportation mode.

Conservation Measures:

1. Moab Wash would be reconstructed in its general present alignment. The channel would be lined with riprap and designed to carry the estimated runoff volume for a 200-year flood. Larger flows would be allowed to flood into channel overbank areas.
2. DOE's contractor would verify that radium-226 concentrations in soil within the Moab Site boundary did not exceed EPA standards in 40 CFR 192. The entire site would then be graded and re-contoured. The water storage ponds would be backfilled to original grades prior to reclamation. Approximately 425,000 yd^3 of fine-grained silty- to sandy-loam reclamation soil excavated from the Floy Wash borrow area (or other suitable site) would be imported as backfill for the Moab Site.

Remediation of Ground Water Contamination:

DOE's proposed action for ground water remediation at the Moab Site is to design and implement an active remediation system and also apply ground water supplemental standards (see below). These actions would be in addition to the initial and interim actions described below. Ground water remediation would be implemented under both the on-site and off-site tailings disposal alternatives. The remediation system would be designed to intercept contaminated ground water that is currently discharging into the near-bank, shoreline area of the Colorado River, which is designated critical habitat for endangered fish species. It is estimated that up to 5 years may be required to design and construct the remediation system. Once the system is implemented, up to 5 years of operation may be required before the action becomes completely effective and provides the requisite protection in the adjacent surface waters. DOE

claims these time frames are conservative, and the time needed to design, implement, and achieve protective levels may be substantially less. In addition, the proposed action would, at a minimum, meet the protective surface water criteria. It is possible that effects of the interim action and the proposed action may achieve background surface water quality conditions in less than the estimated 10 years after the ROD. The system would be operated until ground water contaminant concentrations decreased to a level that would no longer present a risk to aquatic species. This is predicted to be 75 years for DOE's preferred ground water remediation alternative (Figure 2). More detailed information is presented in Section 2.3 of the EIS.

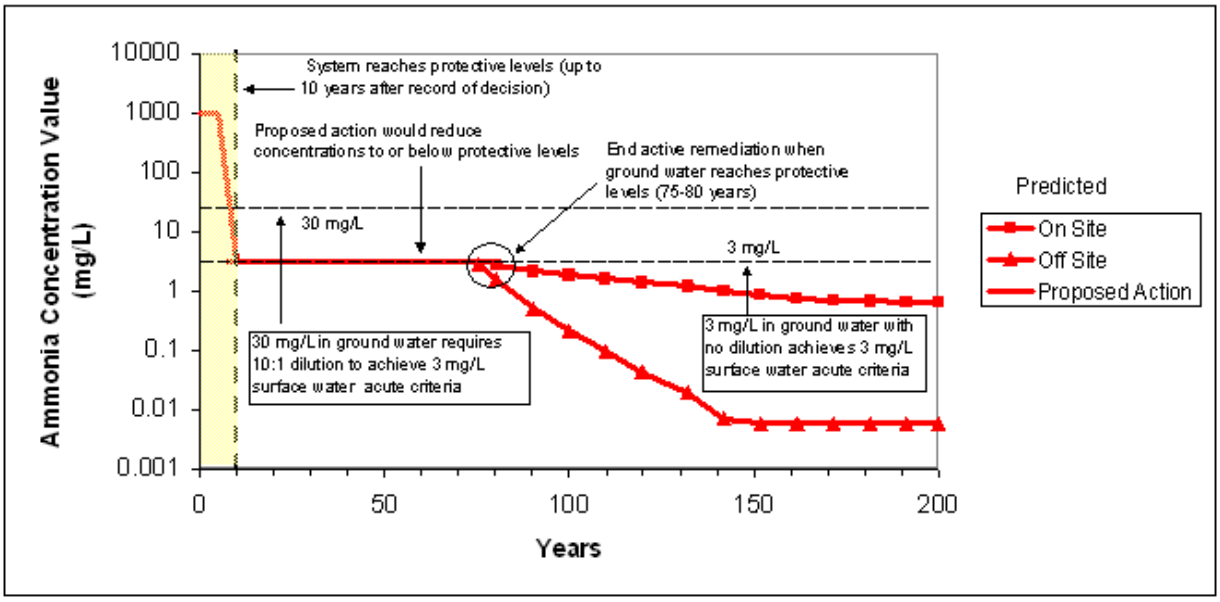

Figure 2. Predicted Maximum Ammonia Concentrations in Ground Water for Active Remediation

Supplemental standards (40 CFR 192), would also be applied to ground water at the site. The uppermost aquifer at the Moab Site contains a highly saline (salty) water, often referred to as brine, which can be as thick as 400 ft, overlain with a thin layer of less salty water. Because ground water in the major portion of the uppermost aquifer has a TDS content exceeding 10,000 milligrams per liter (mg/L), the aquifer meets the definition of a limited-use aquifer as described in EPA's *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy* (EPA 1988). Supplemental standards are regulatory standards that may be applied when the concentration of certain constituents (in this case, total dissolved solids [TDS]) exceeds the normally applicable standards (e.g., MCLs; see 40 CFR 192, Subpart C for further explanation) for reasons unrelated to site contamination.

Remediation Goals for Contaminants of Concern: Aquatic goals - Remediation goals are based on the contaminants of concern identified in Appendix A2 of the EIS (refer to Table 2). In Appendix A2 of the EIS, *Screening of Contaminants to Aquatic and Terrestrial Resources*, DOE identified ammonia, copper, manganese, sulfate, and uranium as the chemical contaminants of concern. The primary contaminant of concern that would require ground water remediation is

ammonia. The area of contamination varies with hydrologic regime but in general is confined to an area less than 53,800 ft^2 (approximately 1.25 acres) (USGS 2002).

Remediation goals for ammonia include the acute and chronic benchmarks based on ambient pH and temperature conditions in compliance with the National Recommended Water Quality Criteria (NWQC) (EPA 2002) and currently proposed Utah Water Quality Standards (UAC 2003, UDEQ 2003). The approach for setting the goals is discussed in Section 2.3 of the EIS. It is DOE's position that achieving a target goal of approximately 3 milligrams per liter (mg/L) for ammonia in ground water would result in compliance with the range of surface water standards in the Colorado River. The 3-mg/L target goal represents the low end of the reasonable range of acute standards. The 3-mg/L concentration represents a 2- to 3-order-of-magnitude decrease in the center of the ammonia plume and would be expected to result in a corresponding decrease in surface water. In addition, based on analysis of collocated samples of interstitial ground water (pore water) and surface water, additional dilution occurs as the ammonia moves from the bank of the river into the water column. The dilution is estimated to be an average of 10-fold (DOE 2003a, 2005a). The combination of active remediation, dilution into surface water, and the tendency for ammonia to volatilize should result in compliance with both acute and chronic ammonia standards in the river everywhere adjacent to the site. It is anticipated that ground water remediation would decrease and maintain the concentrations of all contaminants of concern at levels protective of aquatic species.

Table 2 . Minimum, Maximum, Background Range, Total Number of Samples, and Number of Samples Above Detection Limit for Contaminants of Potential Concern at the Moab Site, Utah (2000–2002 data)

Contaminant of Potential Concern	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Background Concentration Range (mg/L)	Total Number of Samples	Number of Samples above Detection Limit
Aluminum	0.005	0.348[a]	0.008–0.14	182	84
Ammonia[b]	**0.05**	**1440**	**0.05–0.134**	**266**	**266**
Antimony	<0.001	0.0005[c]	0.0005 [c]	62	0
Arsenic	<0.006	0.002[d]	<0.0006–0.002	71	42
Barium	0.002	0.211	0.051–0.14	186	185
Beryllium	<0.0001	0.00005	0.00005 [c]	3	0
Bismuth	<0.001	0.0005 [c]	0.0005 [c]	3	0
Boron	0.064	1.74	<0.0801–0.123	76	65
Cadmium	<0.0001	0.004	<0.00005 [c]	114	11
Chloride	22	17300	25–172	301	301
Chromium	<0.0005	0.0005 [c]	<0.0005–<0.0013	62	1
Copper	**<0.00049**	**0.051** [a]	**<0.0006–<0.0014**	**182**	**61**
Gross Alpha	1.1	665.45	7.31–13.82	93	
Iron	<0.003	7.23	0.0075–4.17	119	73
Lead	<0.0008	0.0005 [c]	0.00005 [c]	104	0
Lithium	0.0552	0.31 [d]	0.057 [d]	18	15
Manganese	**0.0005**	**12**	**<0.003–0.076**	**260**	**147**
Mercury	<0.0002	0.002 [a]	0.00005 [c]	96	1
Molybdenum	<0.001	1.91	<0.0028–0.007	290	275
Nickel	<0.0006	0.052	<.0006–0.002	56	19
Nitrate	0.829	21.7	1.86–5.51	76	75
pH	6.83	8.89	7.38–8.6	423	NA
Selenium	<0.0005	0.026	0.0013–0.0079	216	206
Silver	<0.00005	0.0025 [c]	0.000025–0.00005 [c]	63	0
Strontium	0.005	10.2	0.965–1.63	136	133
Sulfate	**72**	**14400**	**84.1–439**	**301**	**290**
Thallium	<0.001	0.0005 [c]	0.0005 [c]	63	21
Uranium	**0.0013**	**5.12**	**0.0023–0.008**	**331**	**331**
Vanadium	0.0003	0.249	0.00073–0.0031	148	132
Zinc	<0.0008	0.023	<0.0017–0.006	112	50

[a]Analyte is estimated, based on laboratory qualifier.
[b]All ammonia samples were converted for this assessment to total ammonia as nitrogen.
[c]All analytes were below detection; maximum value based on one-half of detection limit.
[d]Analytes in data set represent multiple detection limits. Analytes above this value are below detection limits.

Remediation Goals for Contaminants of Concern: Terrestrial goals -
Remediation goals for terrestrial or avian species have not been established. This is due to limited potential for threatened or endangered receptors (both plant and animal) to be adversely affected by contaminated surface water or ground water. Limited potential is based on the risk analysis in Appendix A2 of the EIS and includes potential exposure pathways, potential presence of species, and potential use of ground water or surface water. Although specific goals are not established, concentrations of contaminants of concern would be reduced by proposed ground water remediation, which would reduce concentrations in surface water.

As a result of remediation, contaminants may concentrate in an evaporation pond. If concentrations presented a risk to threatened or endangered species DOE would inform USFWS, and reasonable and prudent measures would be agreed upon and implemented in order to minimize take. If adverse effects could not be avoided, DOE has committed to additional Section 7 consultation.

Initial and Interim Actions at the Moab Site as Related to the Proposed Action - Upon accepting responsibility for the Moab Site, DOE initiated consultations with USFWS. Based on these consultations, and after reviewing historical surface water quality studies and data, DOE and USFWS both agreed that an immediate risk was posed to endangered fish and designated critical habitat. The source of the risk was identified as elevated concentrations of site-related ground water contaminants (primarily ammonia) reaching the Colorado River.

On April 30, 2002, USFWS concurred with DOE's determination to implement an initial action, followed by an interim action. The goal of the initial action was to dilute ammonia concentrations at the ground water–surface water interface in areas that presented the greatest potential for fish to be present, when backwater habitat has developed. It was estimated that backwater habitat would most likely be present from June through August at flows of 5,000 to 15,000 cubic feet per second (cfs). The action focused on the segment of the Colorado River from Moab Wash extending approximately 800 feet (ft) downriver; that segment contributes the highest concentrations of contaminants to the river. The initial action was designed to take fresh water upstream of the site and pump it through a distribution system to backwater areas. The system was not installed in 2003 due to low flows. The system was installed and tested in 2004 but not fully implemented because the targeted backwater areas never held water. This was due to low river flows caused by drought. It is anticipated that the initial action would be phased out as the interim and subsequent ground water remediation actions reduce ammonia to safe concentrations.

The goal of the interim action is to extract contaminated ground water near the Colorado River, thereby reducing the amount of contamination reaching the river. DOE funded, designed, and implemented the system (Phase 1) in 2003, which included 10 extraction wells aligned parallel to the Colorado River. The system is designed to withdraw ground water at the rate of approximately 30 gallons per minute (gpm) and pump it to an evaporation pond on top of the existing tailings pile. On April 4, 2004, USFWS concurred with DOE's determination to construct a land-applied sprinkler system designed to increase evaporation rates. The system was installed in the existing evaporation pond area. In July 2004, DOE added another 10 extraction wells (Phase 2) near the first 10 wells to increase the rates of ground water extraction and to test

the effects of freshwater injection on surface water concentrations. If the interim actions are successful, a reduction in contaminant concentrations in surface water could be observed significantly sooner than the 10-year time frame considered under the proposed action.

As reported in DOE's *Fall 2004 Performance Assessment of the Ground Water Interim Action Well Fields at the Moab, Utah, Project Site* (DOE 2005b) the Phase 1 well field removed an estimated total volume of 5,246,106 gallons of ground water between June and October of 2004. The estimated total masses of ammonia and uranium removed by Phase 2 wells during this period were 16,700 and 55 kg, respectively. During September and the first week in October of 2004, Phase 2 extraction wells removed an estimated total ground water volume of 821,583 gallons. The mass withdrawals of ammonia and uranium associated with this extraction volume were 3,130 and 7 kg, respectively.

Ground Water Remediation Options – DOE proposes that active ground water remediation would consist of one or a combination of the options described below. All proposed remediation options would occur within the footprint of historical millsite activities and areas requiring surface remediation. Figure 3 shows the area of proposed ground water remediation. Final selection of the most appropriate option(s) would be documented in DOE's remedial action plan (RAP) and would depend upon which surface disposal alternative is selected. These options, which are described in detail in Section 2.3 of the EIS include:

- Ground water extraction, treatment, and disposal
- Ground water extraction and deep well injection (without treatment)
- In situ ground water treatment
- Clean water application

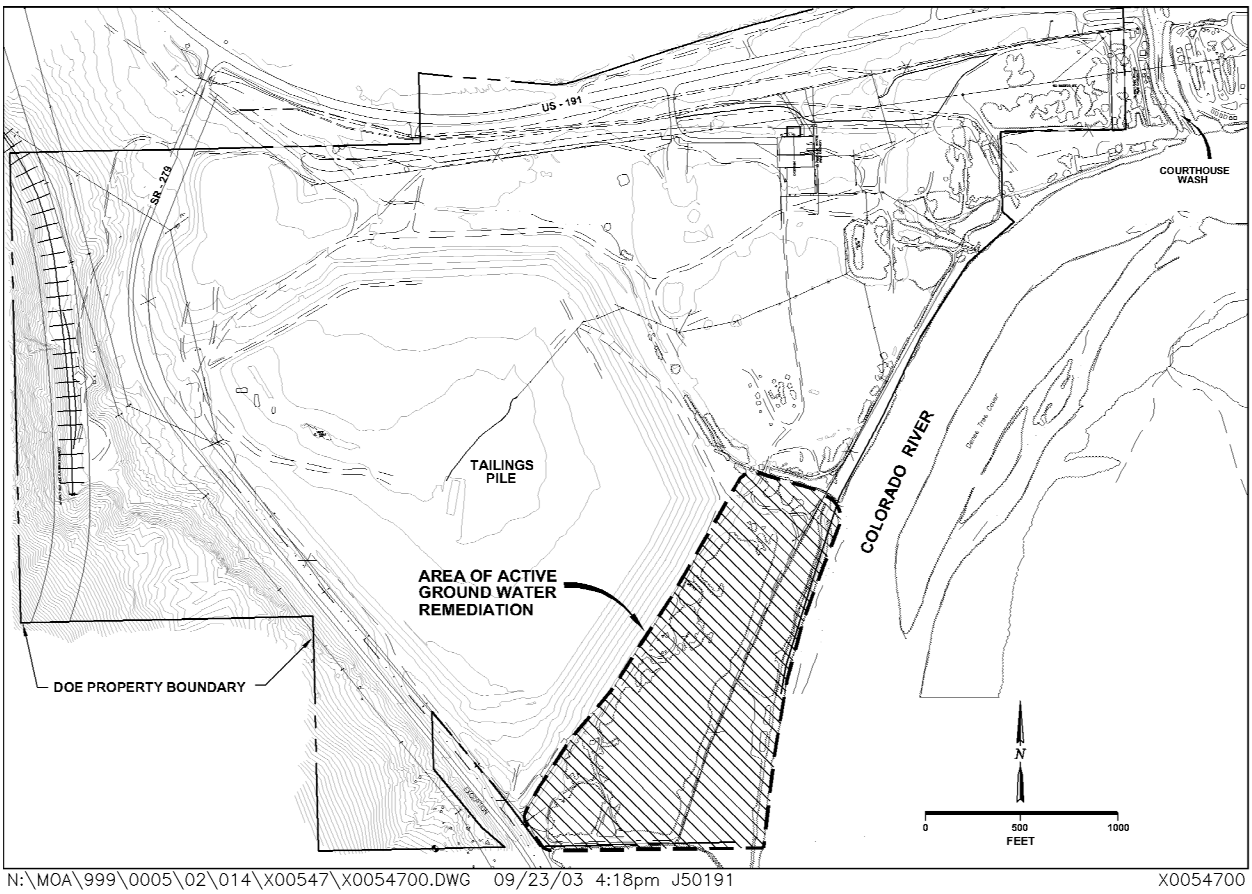

Figure 3. Area of Proposed Active Ground Water Remediation

Ground Water Extraction: The two proposed methods for extracting contaminated ground water are extraction wells or interception trenches.

If extraction wells were used, between 50 and 150 wells would be installed to depths of up to 50 ft using conventional drilling equipment. This design would allow for extracting up to 150 gpm of contaminated ground water. The water would be pumped from the wells to a treatment collection point (e.g., evaporation pond) via subsurface piping. The system would be installed between the current tailings pile location and the Colorado River to intercept the plume before it discharged to the river and would require up to 50 acres of land for the duration of ground water remediation. The proposed locations are within the area of historical site disturbances and areas requiring remediation of contaminated soils. It is expected that the system would be installed after any remediation of surface soils required in these areas. It is possible that some extraction wells would need to be installed adjacent to the river in areas northeast of the tailings pile in the vicinity of the old millsite.

If shallow trenches were used, they would be constructed to intercept shallow ground water, which would be piped via shallow subsurface piping to a collection point for treatment (e.g., evaporation pond). This design would allow for extracting up to 150 gpm of contaminated ground water. It is estimated that the system would require from 1,500 to 2,000 lineal ft of trenches and could affect up to 50 acres of land for the duration of ground water remediation. The proposed locations are within the area of historical site disturbances and areas requiring remediation of contaminated soils.

Treatment Options: DOE has screened potential treatment technologies, which would be applicable for treatment of ammonia and other contaminants of concern (DOE 2003a). The treatment options and technologies described below are meant to bound the range of viable possibilities. All treatment options would require construction of infrastructure. The level of treatment would depend largely on the selected method of effluent discharge. Therefore, specific treatment goals could not be established until the specific discharge method(s) were selected. The treatment goals would have to consider risk analysis and regulatory requirements.

Additional testing, characterization, or pilot studies may be required before the optimum system could be selected and designed. This level of design would be developed in a RAP following publication of the ROD. The Site Observational Work Plan (SOWP) (DOE 2003a) presents more detailed descriptions and discussion of the screening process for the following treatment options.

- Standard evaporation
- Enhanced evaporation
- Distillation
- Ammonia stripping
- Ammonia recovery
- Chemical oxidation
- Zero-valent iron
- Ion exchange
- Membrane separation
- Sulfate coagulation

Because evaporation is a primary treatment consideration and is also considered a disposal option, it was included in more detail in the BA. Evaporation treats extracted ground water by allowing the water to evaporate due to the dry conditions of the site and warm temperatures during part of the year. Influent rates to the ponds would match the rate of natural evaporation. Nonvolatile contaminants would be contained and allowed to concentrate, which would require provisions for disposal of the accumulated solids. Evaporation could also be used to treat concentrated wastewater from treatment processes such as distillation and ion-exchange that produce a wastewater stream. Passive evaporation would not require any mixing after disposal in the ponds. If it were determined that concentrations would present a risk to avian or terrestrial species, a wildlife management plan would be submitted to the USFWS.

Solar evaporation would consist of putting the water into large, double-lined outdoor ponds built in the floodplain to withstand 100-year precipitation and flood events. In the absence of enhanced methods, a sufficiently large pond or ponds would need to be constructed in order to achieve evaporation rates that could keep up with extraction rates and complete remediation in a reasonable time frame. Estimated pond areas could range up to 40 acres, and a total of 60 acres of land would need to be disturbed. This would also require some type of small support facility. Devices such as spray nozzles could considerably enhance evaporation rates.

Disposal Options: If ground water were treated by a method other than evaporation, the treated water would require disposal by one of the following methods: discharge to surface water, shallow injection, or deep well injection. The Colorado River is a boundary to the Moab Site, and it would be the natural repository of the site ground water if effluent were discharged to surface water. Based on water quality standards and designation as critical habitat for endangered fish, it is likely that this option would require extensive water treatment for all contaminants of concern. If discharge to the river was considered a viable alternative for dealing with treatment effluent, appropriate permits would need to be obtained from the state, and compliance with conditions such as discharge rates and effluent composition would be required.

If shallow injection were selected, injection wells would be used to return the treated ground water directly back into the alluvial aquifer. Treated ground water could potentially be used to recharge the aquifer at different points to allow manipulation of hydraulic gradients. This could facilitate extraction of the lower quality water and faster removal of the contaminant source. This option would require treatment of ammonia.

If deep well injection were selected, treated ground water would be disposed of by deep well injection into the Paradox Formation, Leadville Limestone, or deep brine aquifer. Ground water hydrology beneath the site includes a deep salt formation called the Paradox Formation overlain by a deep aquifer with a high salt concentration (brine water). This method would likely require an underground injection control permit from the State of Utah.

Ground Water Extraction and Deep Well Injection (without treatment): Under this scenario, ground water would be extracted using a system and infrastructure similar to that described above, and untreated water would be pumped into a geologically isolated zone. This option would likely require an underground injection control permit from the State of Utah and concurrence from NRC.

In Situ Remediation: If this option were selected, it would include some form of biodegradation, including but not limited to phytoremediation. This option would require minimal infrastructure and could require state or federal permits, depending on the method of biodegradation.

Clean Water Application: Another aspect of the active remediation system could involve some form of application of clean water to dilute ammonia concentrations in the backwater areas along the Colorado River where potentially suitable habitat for endangered fish may exist. This would likely take either or both of two possible configurations. The first configuration would consist of diverting uncontaminated water from the Colorado River through a screened intake at the nearest location just upstream of Moab Wash. A water delivery system consisting of a pump and aboveground piping would redistribute the water to the backwater areas along a section of the sandbar of up to 1,200 ft beginning just south of Moab Wash. Flow meters and valves would be used to measure and control the rate of upstream river water released at each distribution point to minimize turbidity and velocities. The components and operation would be similar to the 1,360-gpm system originally planned as an initial action for the sandbar area adjacent to the site (DOE 2002a) or some alternative system design.

A variation of the clean water application could consist of using injection wells or an infiltration trench to deliver uncontaminated river water indirectly to the backwater areas. For this second configuration, clean water would be collected from the Colorado River and pumped to the site water storage ponds to control suspended sediment and prevent system clogging. The storage pond water would then be introduced to the shallow ground water system by a series of injection wells or infiltration trenches located along the bank adjacent to the backwater areas. The clean water would enter the backwater areas by bank discharge of ground water to provide dilution of ammonia concentrations. This clean water application system could also be combined with the extraction wells discussed earlier to control drawdown and minimize the potential for brine upconing. For this case, up to 150 gpm of uncontaminated river water would be needed to balance the amount of plume water extracted.

DOE will fully describe their final approach to ground water remediation in the RAP, which the Service will review to determine the need for additional Section 7 consultation.

Implementation and Operation - DOE estimates that design, procurement, testing, construction, and implementation of an active ground water remediation system would be complete within 5 years of issuance of the ROD. Design criteria and specifications would depend upon whether the on-site or off-site alternative is selected for tailings disposal.

After the system begins operation, DOE estimates that as much as an additional 5 years would be required to reduce concentrations of contaminants in the surface water to levels that are protective of aquatic species in the Colorado River, if protective levels were not already achieved as a result of interim actions. However, it is possible that considerably less time may be required to reach protective levels. The active remediation system would extract and treat ground water for 75 to 80 years (depending on whether the off-site or on-site surface remediation alternative were implemented) to maintain surface water quality goals. Contaminant concentrations in ground water would thus be reduced to acceptable risk levels prior to entry into the Colorado River. Active remediation would cease only after ground water and surface water monitoring confirmed that long-term remediation goals were achieved and after appropriate consultation and concurrence with USFWS. The uncertainties and assumptions associated with the success of active remediation are discussed below.

DOE would monitor the progress of remedial actions to determine if goals are being met and would commit to ongoing consultation with USFWS. In addition, DOE would provide monitoring data and remediation results annually to USFWS.